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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/854,083	05/11/2001	Zhengquan Tan	A5771/T42200	6984

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APPLIED MATERIALS, INC.  
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SANTA CLARA, CA 95050

EXAMINER

COLEMAN, WILLIAM D

ART UNIT PAPER NUMBER

2823

DATE MAILED: 01/21/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/854,083

Applicant(s)

TAN ET AL

Examiner

W. David Coleman

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 07 January 2002.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-141 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-41 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application)  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s) \_\_\_\_\_
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 10 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Response to Arguments*

Applicant's arguments with respect to claims 1-41 have been considered but are moot in view of the new ground(s) of rejection.

### *Claim Rejections - 35 USC § 102*

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1, 2, 3, 4, 5 and 25 are rejected under 35 U.S.C. 102(e) as being anticipated by Bhan et al., U.S. Patent 6,090,167.

3. Pertaining to claims 1 and 2, Bhan discloses a semiconductor process as claimed. See **FIGS. 1-7**, where Bhan discloses a method for forming a silicon oxide layer over a substrate disposed in a high density plasma substrate processing chamber, said method comprising:

flowing a process gas into the substrate processing chamber **10**, said

process gas comprising a silicon-containing source SiH<sub>4</sub> (column 12, line 15), an oxygen-containing source O<sub>2</sub> (column 1, line 63) and a fluorine-containing source C<sub>2</sub>F<sub>6</sub> (column 12, line 17);

forming a plasma from said process gas; and

heating the substrate **12** to a temperature above 450<sup>0</sup>C during deposition (see FIG. 2, schematic location 210) of said silicon oxide.

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4. Pertaining to claim 3, Bhan discloses wherein the substrate is maintained at a temperature of 500<sup>0</sup>C (column 11, line 67).
5. Pertaining to claim 4, Bhan teaches wherein said silicon-containing gas is SiH<sub>4</sub>.
6. Pertaining to claim 5, Bhan fails to teaches wherein the oxygen-containing source is O<sub>2</sub>.
7. Pertaining to claim 25, Bhan teaches wherein the silicon oxide layer is used as a premetal dielectric layer (intermetal dielectric, column 4, line 49) or part of a shallow trench isolation structure.

***Claim Rejections - 35 USC § 103***

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

Applicant has provided evidence in this file showing that the invention was owned by, or subject to an obligation of assignment to, the same entity as assigned at the time this invention was made. Accordingly, Bhan et al., U.S. Patent 6,090,167 is disqualified as prior art through 35 U.S.C. 102(f) or (g) in any rejection under 35 U.S.C. 103(a) in this application. However, this applied art additionally qualifies as prior art under another subsection of 35 U.S.C. 102 and accordingly is not disqualified as prior art under 35 U.S.C. 103(a).

Applicant may overcome the applied art either by a showing under 37 CFR 1.132 that the invention disclosed therein was derived from the invention of this application, and is therefore, not the invention "by another," or by antedating the applied art under 37 CFR 1.131.

9. Claims 6, 7, 8 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bhan et al., U.S. Patent 6,090,167 as applied to claims 1, 2 3 and 4 above, and further in view of Applicants prior art.

10. Pertaining to claim 6, Bhan fails to disclose wherein said silicon oxide layer has a fluorine content of less than 1.0 at. %. Applicants admitted prior art teaches wherein many semiconductor manufactures require that PMD or STI have less than 1.0 at. % fluorine (page 3, lines 20-21). In view of Applicants admitted prior art, it would have been obvious to one of ordinary skill in the art to have a fluorine content of less than 1.0 at. % because fluorine is more likely to outgas and migrate into an adjacent layer (page 3, lines 17-19).

11. Pertaining to claim 7, Bhan teaches wherein said fluorine-containing source is either NF<sub>3</sub> or a fluorocarbon having a formula of C<sub>n</sub>F<sub>2n+2</sub> where n is a positive integer (column 2, line 32).

12. Pertaining to claim 8, Bhan fails to teach wherein the plasma has an ion density of at least  $1 \times 10^{11}$  ions/cm<sup>3</sup> (column 13, line 11).

13. Pertaining to claim 9, Bhan fails to teach the flow ratio of said oxygen-containing source to said silicon-containing source is between 1.4-3.0:1.

14. It would have been obvious to disclose the ion density and the flow ratio of the oxygen-containing source to silicon containing source of the combined references for the following reasons. Given the teaching of the references, it would have been obvious to determine the optimum thickness, temperature as well as condition of delivery of the layers involved. See *In re Aller, Lacey and Hall* (10 USPQ 233-237) "It is not inventive

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to discover optimum or workable ranges by routine experimentation. Note that the specification contains no disclosure of either the critical nature of the claimed ranges or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Any differences in the claimed invention and the prior art may be expected to result in some differences in properties. The issue is whether the properties differ to such an extent that the difference is really unexpected. *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986)

Appellants have the burden of explaining the data in any declaration they proffer as evidence of non-obviousness. *Ex parte Ishizaka*, 24 USPQ2d 1621, 1624 (Bd. Pat. App. & Inter. 1992).

An Affidavit or declaration under 37 CFR 1.132 must compare the claimed subject matter with the closest prior art to be effective to rebut a prima facie case of obviousness. *In re Burckel*, 592 F.2d 1175, 201 USPQ 67 (CCPA 1979).

15. Claims 10-24 and 29-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicants admitted prior art in view of Bhan et al., U.S. Patent 6,090,167.

16. Pertaining to claims 10, 17, 28 and 29, Applicants admitted prior art discloses a semiconductor process substantially as claimed. See pages 2-3 of Applicants disclosure where Applicants teach a method for forming a silicon oxide layer over a substrate disposed in a high density plasma substrate processing chamber, said method comprising:

(a) flowing a first gas (Ar and O<sub>2</sub>) into the substrate processing chamber;

17. (c) flowing a process gas comprising a silicon-containing source, an oxygen-containing source and a fluorine containing source into said substrate processing

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chamber. However, Applicants admitted prior art fails to teach: (b) forming a plasma having an ion density of at least  $1 \times 10^{11}$  ion/cm<sup>3</sup> from said first gas and (d) forming a plasma having an ion density of at least  $1 \times 10^{11}$  ions/cm<sup>3</sup> from said process gas and allowing said plasma to heat said substrate to a temperature at or above 450°C during deposition of said silicon oxide layer. Given the teaching of the references, it would have been obvious to determine the optimum thickness, temperature as well as condition of delivery of the layers involved. See *In re Aller, Lacey and Hall* (10 USPQ 233-237) "It is not inventive to discover optimum or workable ranges by routine experimentation. Note that the specification contains no disclosure of either the critical nature of the claimed ranges or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. *In re Woodruff*, 919 f.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Pertaining to claims 27, Bhan teaches wherein the silicon oxide layer is used as a premetal dielectric layer.

Pertaining to claims 29 and 30, Applicants admitted prior art teaches a gapfill process.

Pertaining to claim 31, Applicants admitted prior art discloses a fluorine content of less than 1%. It appears that 0.6% is less than 1%.

Pertaining to claims 32 and 33, Applicants admitted prior art teaches SiH<sub>4</sub>, which is a silicon containing gas and O<sub>2</sub>, which is a oxygen containing gas.

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18. Pertaining to claims 11, 12, 15 and 15, Applicants admitted prior art teaches an oxygen-containing source  $O_2$ , a silicon-containing source  $SiH_4$  and a fluorine content of less than 1.0 at. %.

Pertaining to claims 13, 16, 20 and 21, Applicants admitted prior art fails to teach wherein said fluorine-containing source is either  $NF_3$  or a gas having the formula of  $C_nF_{2n+2}$  where n is a positive integer and the plasma heats said substrate to a temperature of  $500^{\circ}C$  or more. Bhan teaches wherein the fluorine-containing source is either  $NF_3$  or a gas having the formula of  $C_nF_{2n+2}$  where n is a positive integer and the plasma heats said substrate to a temperature of  $500^{\circ}C$  or more. In view of Bhan, it would have been obvious to one of ordinary skill in the art to incorporate the fluorine-containing source of Bhan and the plasma heating of said substrate to a temperature of  $500^{\circ}C$  or more in Applicants admitted prior art because the Examiner believes the motivation is to fabricate stable dielectric films.

19. Pertaining to claims 14, 18, 19, 22, 23 and 24, Applicants admitted prior art fails to teach wherein the fluorine content is less than 1.0 at. %, and fails to teach flow ratios of the process gases. Given the teaching of the references, it would have been obvious to determine the optimum thickness, temperature as well as condition of delivery of the layers involved. See *In re Aller, Lacey and Hall* (10 USPQ 233-237) "It is not inventive to discover optimum or workable ranges by routine experimentation. Note that the specification contains no disclosure of either the critical nature of the claimed ranges or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant



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must show that the chosen dimensions are critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Any differences in the claimed invention and the prior art may be expected to result in some differences in properties. The issue is whether the properties differ to such an extent that the difference is really unexpected. *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986)

Appellants have the burden of explaining the data in any declaration they proffer as evidence of non-obviousness. *Ex parte Ishizaka*, 24 USPQ2d 1621, 1624 (Bd. Pat. App. & Inter. 1992).

An Affidavit or declaration under 37 CFR 1.132 must compare the claimed subject matter with the closest prior art to be effective to rebut a prima facie case of obviousness. *In re Burckel*, 592 F.2d 1175, 201 USPQ 67 (CCPA 1979).

20. Claims 34, 35, 36, 37, 38, 39, 40 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicants admitted prior art in view of Bhan et al., U.S. Patent 6,090,167 as applied to claims 10-24 and 28-31 above, and further in view of Nag et al., U.S. Patent 6,268,297 B1.

21. The combined teachings of Applicants admitted prior art in view of Bhan discloses a semiconductor process substantially as claimed. However, the combined teachings fail to teach wherein the silicon oxide layer is doped with a phosphorous source containing PH<sub>3</sub>. Nag teaches a high density plasma oxide wherein the oxide is doped with a phosphorous source containing PH<sub>3</sub>. See column 3, lines 46-68, where Nag teaches doping an oxide with a PH<sub>3</sub> source. In view of Nag, it would have been obvious to one of ordinary skill in the art to incorporate the phosphorus source, PH<sub>3</sub> of Nag into the combined teachings of Applicants admitted prior art and Bhan because phosphorous-

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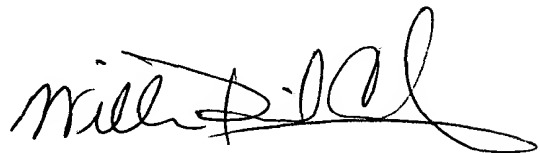
doped film serves as a barrier to mobile-ions that may be in the vicinity of transistors (column 3, lines 51-54).

*Conclusion*

22. Any inquiry concerning this communication or earlier communications from the examiner should be directed to W. David Coleman whose telephone number is 703-305-0004. The examiner can normally be reached on 9:00 AM-5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 703-306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7721 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.



W. David Coleman  
Examiner  
Art Unit 2823

WDC  
January 13, 2003